Agricultural Profits and Farm Household Wealth

Steven C. Blank, Kenneth W. Erickson, Charles B. Moss, and Richard Nehring

Recent decades (especially since 1973) have been an era of decreasing production profits that threaten the survival of many mid- and small-sized American farms (Blank 2003). Normally, the survival of a firm depends on its profitability, both in absolute and relative terms. To remain viable, a firm must offer returns that are both sufficient to cover the owner's financial obligations and competitive with returns from alternative investments. If a firm is profitable, the wealth of its owners can increase over time. An unprofitable firm, on the other hand, reduces owners' wealth. Yet, American agriculture is full of firms that routinely earn low or negative returns on equity from production operations (Blank 2002), thus complicating the evaluation of the industry's economic health and prospects. This suggests that macro-level forecasts of American agriculture's future structure and performance require a micro-level understanding of the relationship between farm profits and owner wealth. This paper addresses that relationship.

Assessing financial stress within American agriculture involves identifying which groups are more or less profitable. It also involves assessing farmers' well-being in the context of income, wealth, and consumption at the household level (Mishra et al.). Previous studies (e.g., Dodson) raise expectations of profitability differences due to resources available (and quality) across locations, economies of scale across farm sizes, and supply/demand differences across commodity markets caused by comparative advantage (i.e., competitiveness) issues. However, economic theory says that returns converge over time as resources flow into more profitable industries and out of less profitable industries, causing factor price changes (O'Rourke and Williamson, Caselli and Coleman). Both traditional growth and trade theories say factor markets will adjust to equalize commodity returns over time (Andres, Bosca, and Domenech; Ben-David; Gutierrez; Schott).

Assessing farm owner–operator wealth involves understanding that farmers are making production decisions based on total household wealth, not just on farm production profitability (Carriker et al., Schmitt). We want to explain wealth patterns across regions, farm sizes, and commodity specialization to derive insights into the future financial prospects for American agriculture as a whole, or at least for some agricultural industries. We also want to test the relationships between farm size and productivity, and productivity and profitability.

There are three general objectives of the paper. The first objective is to determine whether or not there is convergence of rates of return on farm assets across states over time. The second objective is to derive a system of equations

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that explains interlinkages between the various components of a farm household's wealth at some point in time. The third objective is to use those equations to empirically assess income and wealth patterns across regions, farm sizes, and commodity specializations.

Theoretical Relationship between Income and Wealth

The three components of income (i.e., economic gains) contributing to wealth are profits from farm output, off-farm income, and capital gains on assets. Total "wealth" (W) is usually expressed as equity at time t: $W_t = W_{t-1} + \Delta W_t$. "Wealth changes" during a time period ending at t equals "farm income" ($FInc$) plus "off-farm income" ($OFInc$) plus some function of "capital gains" (ΔK) minus "consumption" (C), or

$$(1) \qquad \Delta W_t = FInc_t + OFInc_t + \psi \Delta K_t - C_t.$$

In this regard, capital gains (even unrealized gains) immediately improve a farmer's ability to borrow, and thus they aid in financing a larger operation.

There are at least four components of wealth changes. Those components, on the right-hand side of (1), are themselves functions of other factors:

$$(2) \qquad FInc_t = R_t - PC_t - OK_t$$

$$(3) \qquad OFInc_t = Sal_t + Inv_t$$

$$(4) \qquad \Delta K_t = (K_t - K_{t-1})\mathrm{LTV}_t \quad \text{and} \quad \psi = f(\mathrm{LTV})$$

and

$$(5) \qquad C_t = CL_t + QL_t.$$

Each of these four equations is explained below, beginning with farm income.

For this analysis of American farms, farm income comes from three sources. Only total revenues from farmers' and ranchers' sales of production output (R) are considered part of farm income; government transfers and other nonfarm income sources are excluded to test the true sustainability of farm production as an income source. Yet, to many farm households, government payments may be significant. This will be captured in an error term in equations (1) and (2). In equation (3), government payments could come from various sources, such as unemployment benefits. Therefore, the industry's farm income from all agricultural commodities ($i = 1, 2, \ldots, n$) at time t is expressed in (2), where

$$(2a) \qquad R_t = \sum_{i=1}^{n} P_{it} Q_{it}$$

$$(2b) \qquad Q_{it} = Y_{it} A_{it}$$

$$(2c) \qquad PC_t = \Sigma_i \Sigma_j pc_{jt} x_{ijt}$$

$$(2d) \qquad OK_t = \Sigma_i \Sigma_h ok_{ht} z_{iht}$$

and $P_i, pc_j, ok_h > 0$; $Y_i, A_i, x_j, z_h \geq 0$. The number of commodities produced by the industry is n. The average unit price of commodity i at time t is P_{it}. The quantity of commodity i produced during the period ending at time t is Q_{it}. Y_i is the average yield per acre of commodity i. A_i is the total acreage devoted to commodity i. PC_t is the total production costs of all commodities at time t. Unit costs of j variable inputs is pc_j. Quantities of j variable inputs to be applied in the production of commodity i is x_{ij}. OK_t is the total ownership costs of all commodities at time t. Unit costs of h capital inputs (land, improvements, equipment, etc.) is ok_h. Quantities of h capital inputs used in the production of commodity i is z_{ih}.

Equation (3) states that off-farm income for a period ending at time t consists of the sum of off-farm salary or wages earned (Sal) and nonfarm investment or "unearned" income (Inv). Off-farm employment is the primary source of nonfarm income for a majority of farm and ranch households, representing over 90% of average farm household income in recent years (Mishra et al.). Nonfarm investment includes income sources such as interest income on savings, Social Security and other retirement benefits, and capital gains and dividends on nonfarm assets such as stocks and bonds.

Equation (4) specifies how farmers' change in wealth is influenced by capital gains. To begin, capital gains are simply the change in value of a farmer's capital from one period to the next (i.e., $K_t - K_{t-1}$). Capital gains are only realized if the asset is sold. However, some portion of unrealized capital gains can be used to improve a farmer's operation. Lenders will usually loan a farmer up to some specific portion of the market value of the assets, referred to as the "loan-to-value" ratio (LTV). In (4), ψ is an estimate of how much of unrealized capital gains are immediately converted into cash, and is assumed to be a function of the LTV. In all cases, $1 > \text{LTV} \geq \psi \geq 0$.

The capital variable (K) in (4) can be expressed as the sum of the market values for all assets (real estate, nonreal estate, and nonfarm assets) held by a farm at time t,

$$\text{(4a)} \quad K_t = LV_t + MV_t + FV_t$$

where LV is the "value of land" and improvements (buildings, irrigation systems, etc.), MV is the "value of nonreal estate assets" (e.g., machinery and other equipment), and FV is the "value of nonfarm financial assets" (stocks, bonds, etc.). Farmland has historically represented about 75% of assets held by farm households. Also, farmland values vary much more than do the other agricultural assets because they are a function of numerous variables (Drozd and Johnson). A simple model for the expected price of farmland can be specified as

$$\text{(4b)} \quad E(LV_{ft}) = E(R_{ft} - CK_{ft} + TFP_{ft} + D_{ft}).$$

An empirical version of (4b) is

$$\text{(4c)} \quad LV_{ft} = \beta_1 R_{ft} - \beta_2 CK_{ft} + \beta_3 TFP_{ft} + \beta_4 \Delta_{ft} + v_f + \varepsilon_t$$

where LV_{ft} is the value of farmland and buildings in state or farm f at time t, R_{ft} is the cash flow (revenue, as specified in (2a)) from agricultural production in state or farm f at time t, CK_{ft} is the average "cost of capital" at time t, TFP_{ft} is a technology variable (state-level "total factor productivity"), we also use a farm-level estimate of "productivity" ($PROD$), the "population density" (people per acre) in county or state f at time t is D_{ft}, β is a coefficient to be estimated, and v_f and ε_t are errors for, respectively, state or farm f or for time t if a random effects model is used.

Equation (5) specifies farm household consumption during a period ending at time t as the sum of the basic cost of living (CL_t), such as the cost of providing a minimum level of food and shelter to members of the household, and the extra expenditures made by household members to raise the quality of life to the desired level (QL_t).

Industry sales and profit totals are simply the sum of results from decisions made by the individual firms that constitute the industry. In American agriculture, individuals are assumed to make production decisions based on the goal of maximizing expected profits. This study follows Klepper in recognizing that results are influenced by both the innovation expertise and capital available within an industry. Thus expected profit, for firm f at time t, is specified as

$$\text{(6)} \quad E(\pi_{ft}) = E[R_{ft} - PC_{ft} - OK_{ft} + (m_f)_g(cr_{ft})G - \Delta(cr_{ft})]$$

where R, PC, and OK are defined as above, but are for firm f only. $E(\cdot)$ is the expected value of $(\cdot)$. The innovation expertise of firm f is denoted m_f and influences the firm's success at improving productivity. The probability of firm f improving its productivity in period t is $(m_f)g(cr_{ft})$, where cr_{ft} is defined as the firm's cumulative investment in human capital and productive resources through time t and is some function of profits earned in all prior periods. The function $g(cr_{ft})$ reflects the opportunities for improving productivity. The potential increase in profits earned by an innovation that improves productivity is G. This can result from either reduced input costs per unit (PC/Q and/or OK/Q) or increased revenue from a higher yield (Y). G is defined to equal $(R_{ft} - PC_{ft} - OK_{ft}) - (R^*_{ft} - PC^*_{ft} - OK^*_{ft})$, where the asterisk indicates a value that would have existed for firm f in period t without the innovation. The change in cumulative investment during period t $[\Delta(cr_{ft})]$ equals $cr_{ft} - cr_{ft-1}$, and it is constrained to be ≥ 0.

A firm's expected sales revenues are

$$\text{(7)} \quad E(R_{ft}) = R_{ft-1} + E[(m_f)_g(cr_{ft})G + \Delta(cr_{ft})].$$

Current revenues are expected to equal the previous year's revenues plus expected improvements from a productivity component $[(m_f)g(cr_{ft})G]$ and an investment component $[\Delta(cr_{ft})]$.

Procedure

We use state-level data from the USDA Economic Research Service (ERS) for 1960–2002 to test for convergence of rates of return on farm assets and over time. Next, we use farm-level data from the USDA's Agricultural Resource Management Survey (ARMS) to help explain the inter-linkages between farm household wealth, returns, and productivity (USDA). We construct a unique pseudo-panel data set from pooled ARMS data for 1996–2002 over three regions: the Lake States, the

Corn Belt, and the Southeast. These regions were selected to represent production sectors dominated by dairy and wheat, corn, and specialty crops, respectively. Then, we estimate the equations using a two-way fixed effects approach (Baltagi, Chapter 3), examining factors affecting profitability and the change in wealth across regions.

Model of Convergence

In this study, we determine whether the rate of return on agricultural assets is converging across regions. A typical formulation of convergence (Sala-i-Martin) can be expressed as

$$(8) \qquad \ln\left(\frac{y_{it}}{y_{*t}}\right) = \alpha_0 + \alpha_1 \ln\left(\frac{y_{i,t-1}}{y_{*,t-1}}\right) + \alpha_2 z_{it} + \varepsilon_{it}$$

where $\ln(\cdot)$ denotes the natural logarithm, y_{it} is the level of income per capita in region or state i in time t, y_{*t} is the index income per capita at time t, z_{it} is a vector of other economic variables (such as initial capital) in region or state i at time t, ε_{it} is an error term, and α_0, α_1, and α_2 are estimated coefficients. In this formulation, if $\alpha_0 \to 0$, $\alpha_1 < 1$, and $\alpha_2 = 0$, the income in region i converges over time toward the income of the index. Further, this convergence is unconditional, or does not depend on other variables (such as initial capital). The convergence is conditional if $\alpha_0 \to 0$, $\alpha_1 < 0$, and $\alpha_2 \neq 0$.

Given that the rates of return on agricultural assets are stationary (results not reported here), we reformulate convergence in (8) into

$$(9) \qquad \ln(y_{it}) - \ln(y_{*t}) = \alpha_0 + \alpha_1[\ln(y_{i,t-1}) - \ln(y_{*,t-1})] + \alpha_2 z_{it} + \varepsilon_{it}$$

$$d_{it} = \alpha_0 + \alpha_1 d_{i,t-1} + \alpha_2 z_{it} + \varepsilon_{it}$$

where d_{it} is the logarithmic difference between returns in state i and the index state at time t. Since the rate of return data for agricultural assets in (9) are stationary, convergence can be estimated directly. Unfortunately, the formulation in (9) cannot be directly applied to agricultural returns because negative rates of return are sometimes observed in the data. Thus, we redefine (9) so that $d_{it} = r_{*t} - r_{it}$, where r_{*t} is the maximum rate of return to agricultural assets in each of ERS's 10 regions. Finally, we estimate α_0 and α_1 in (9) using maximum likelihood.

Estimation of Income and Wealth Patterns

Ideally, one would like to take repeated cross-section surveys of U.S. farm households over time. However, it is impossible to track the same farm household over time. Instead, we construct a pseudo-panel data set. For empirical studies using such panel data, the temporal pattern of a given farm's production behavior must be established. In the absence of genuine panel data, repeated cross-sections of data across farm typologies may be used to construct pseudo-panel data (Deaton, Verbeek and Nijman). A pseudo panel is created by grouping individual observations into homogeneous cohorts, distinguished according to time-invariant characteristics such as fixed assets, geographic location, or land quality. The empirical analysis is then based on the cohort means rather than the individual farm-level observations.

We assigned the farm-level data to cohorts, based on the ERS farm typology (TYP) groups (Hoppe and MacDonald). A cohort group is formed for each state in the sample. There are thirteen cohorts per state and fourteen states, resulting in a total of 182 cross-sectional entities per year. We refer to these entities as "firms."

The problem when using time series and cross-sectional data is to specify a model that will adequately allow for differences in behavior over cross-sectional units as well as for differences in behavior over time for a given cross-sectional unit. Fixed effects regression is a method of controlling for omitted variables in panel data when the omitted variables vary across "firms" but do not change over time. The fixed effects regression model has n different dummy intercepts, one for each firm.

To test if some omitted variables are constant over time but vary across regions, while other variables are constant across states but vary over time, we include both location and time effects. This is done by including both $n-1$ state binary variables and $T-1$ time binary variables in the regression, plus an intercept. The combined time and firm fixed regression model is

$$(10) \qquad y_{it} = \alpha_0 + \alpha_i + \beta' X_{it} + v_i + \varepsilon_t$$

where X_{it} is a vector of other variables to be estimated (from (4c)). This model has an overall constant term as well as a "group" effect for each group and a "time" effect for each time period. The combined time and state fixed effects regression model eliminates omitted variables bias arising from unobserved variables that are constant over time and/or constant across states.

We estimated reduced forms of equations (1), (2), (4c), and (6) for the three regions using unbalanced panels. The equations were estimated by ordinary least squares (OLS) since these equations constitute a recursive system (Baltagi; Greene, p. 659). If we take the α_i's to be identical across locations, OLS provides consistent and asymptotically efficient estimations of α and β (Greene, pp. 560–62).

Empirical Results

Convergence

The empirical results of the convergence model in (9) are presented in table 1. Based on the data for 1960–2002, the state with the highest rate of return within each region was chosen as the index state (y^* in equation (9)). Following this criterion, we use Delaware: Northeast, Minnesota: Lake States, Iowa: Corn Belt, Nebraska: Northern Plains, North Carolina: Appalachia, Florida: Southeast, Arkansas:

Table 1. Estimated Autoregression Coefficients for Difference in Rate of Return on Assets, 1960–2002

State	α_1	α_0	State	α_1	α_0
Connecticut	0.427	0.039	Kentucky	0.904	0.066
	(0.140)	(0.008)		(0.062)	(0.029)
Maine	0.165	0.054	Tennessee	0.946	0.093
	(0.154)	(0.007)		(0.044)	(0.040)
Maryland	0.548	0.038	Virginia	0.931	0.087
	(0.131)	(0.007)		(0.050)	(0.032)
Massachusetts	0.663	0.050	West Virginia	0.413	0.159
	(0.114)	(0.013)		(0.141)	(0.027)
New Hampshire	0.299	0.106	Alabama	0.338	0.018
	(0.150)	(0.023)		(0.147)	(0.003)
New Jersey	0.557	0.049	Georgia	0.485	0.002
	(0.128)	(0.009)		(0.137)	(0.004)
New York	0.722	0.051	South Carolina	0.629	0.030
	(0.105)	(0.014)		(0.131)	(0.008)
Pennsylvania	0.684	0.072	Louisiana	0.210	0.015
	(0.111)	(0.013)		(0.153)	(0.003)
Rhode Island	0.626	0.038	Mississippi	0.327	0.015
	(0.119)	(0.014)		(0.147)	(0.003)
Vermont	0.676	0.044	Oklahoma	0.466	0.006
	(0.112)	(0.014)		(0.139)	(0.002)
Michigan	0.191	0.030	Arizona	0.880	0.009
	(0.153)	(0.004)		(0.075)	(0.017)
Wisconsin	0.449	0.014	Colorado	0.880	0.014
	(0.138)	(0.005)		(0.085)	(0.015)
Illinois	0.365	0.014	Montana	0.824	0.022
	(0.145)	(0.003)		(0.096)	(0.014)
Indiana	0.297	0.023	Nevada	0.755	0.039
	(0.149)	(0.004)		(0.102)	(0.009)
Missouri	0.646	0.042	New Mexico	0.743	0.018
	(0.118)	(0.006)		(0.101)	(0.009)
Ohio	0.358	0.045	Utah	0.853	0.041
	(0.147)	(0.004)		(0.082)	(0.012)
Kansas	0.576	0.012	Wyoming	0.877	0.035
	(0.127)	(0.004)		(0.078)	(0.018)
North Dakota	0.516	0.011	Oregon	0.705	0.048
	(0.133)	(0.007)		(0.108)	(0.005)
South Dakota	0.750	0.003	Washington	0.557	0.011
	(0.103)	(0.007)		(0.128)	(0.004)

Note: Numbers in parenthesis denote standard deviations and all numbers are rounded to the third decimal.

Table 2. Regression Results for Farm Income and Farmland Value Equations by Region: Lake States, Corn Belt, and Southeast (1996–2002)

	Lake States		Corn Belt		Southeast	
Variable	Estimate	t-Value	Estimate	t-Value	Estimate	t-Value
Farm income equation						
CashFlow	0.6300	10.41*	0.1445	5.36*	0.0935	2.48**
TotalCashExpenses	−0.4124	−5.82*	−0.1232	−5.07*	−0.0918	2.22**
Depreciation	−0.3212	0.32	−1.0920	−4.83*	−1.1513	−8.98*
Fixed effects						
Firm	NS		*		NS	
Year	NS		NS		NS	
Farmland value equation						
CashFlow	0.0961	7.88*	0.0367	4.73*	0.1558	3.35**
CostCapital	0.2414	2.03**	−0.1301	−0.84	0.0730	0.36
Productivity	−17.9303	−1.42	−19.4439	−3.12**	−8.2662	−1.45
PopDensity	−3.1103	−0.22	4.8009	1.24	0.2555	0.11
Fixed effects						
Firm	*		*		**	
Year	NS		NS		NS	

* and ** denote statistical significance at the 0.01 and 0.05 confidence levels. NS denotes "not significant."

Delta, Texas: Southern Plains, Idaho: Mountain region, and California: Pacific States. In general, convergence occurs if α_1 is less than 1, implying that the difference between the rate of return for a particular state and the regional index declines over time. The results indicate that all the rates of return to agricultural assets converge over time in all regions except Appalachia. Within the Appalachian region, we fail to reject $\alpha_1 = 1$ at the 0.05 confidence level for Kentucky, Tennessee, and Virginia. Thus, at least conditional convergence for the rate of return on agricultural assets is supported in all regions except Appalachia.

To test unconditional convergence, we next examine convergence between each of the index states. North Carolina, the state with the highest average returns over the period, is used to normalize the index states for each region. Again, the estimated autoregression coefficient for each region is less than 1 at any conventional level of statistical significance. Thus, we conclude that the rates of return on agricultural assets are converging across regions.

Farm Income, Land Values, Wealth, and Profits Equations

The regression results were generally "best" for the Lake States and Corn Belt since coefficients' signs were generally consistent with economic theory, and levels of significance were high, especially for the farm income equation.

Farm income (equation (2)). The results in the top section of table 2 show some differences across regions. *CashFlow* and *TotalCashExpenses* were significant in all three regions, but with varied coefficients. *Depreciation* was not significant in the Lake States, possibly indicating farm structures with relatively greater fixed assets. Firm fixed effects were significant in the Corn Belt, indicating that other firm-related variables also possibly affecting farm income (such as commodities produced) are omitted.

Farmland value (equation (4c)). CashFlow was significant in all three regions (bottom section of table 2). This is consistent with the expectation that land value is determined primarily by its ability to generate agricultural revenues. The *Productivity* variable was only significant in the Corn Belt. This may be due to the more heterogeneous nature of operations in the Southeast and Lake States.

Change in wealth (equation (1)). Wealth consists of both farm and nonfarm capital, although most farm household wealth is held in the form of farmland. Both components were highly significant in the combined three-region area when examining changes in farm wealth across farm sizes (top of table 3). Income generally was not significant, thus wealth comes from capital, not income, for all farm sizes.

Table 3. Regression Results for Change in Wealth and Profits Equations by Farm Size: Lake States, Corn Belt, and Southeast Regions Combined (1996–2002)

	Farm Size 1		Farm Size 2		Farm Size 3	
Variable	Estimate	*t*-Value	Estimate	*t*-Value	Estimate	*t*-Value
Change in wealth equation						
FarmInc	0.1662	0.48	0.3110	1.63	0.0005	0.00
NonFarmInc	−0.1638	−1.47	−0.4293	−1.88*	−1.6816	−0.88
ChngFarmCap	0.9908	118.62***	0.9374	69.83***	0.2568	21.68***
ChngNFarmCap	0.8597	30.58***	0.9439	18.94***	0.6524	2.22**
Consumption	0.2698	0.93	−1.0688	−1.96**	2.3527	0.92
Fixed effects						
Year	***		***		NS	
Profits equation						
CashFlow	0.0129	0.51	0.0771	3.48**	0.0054	5.82***
TotalExpenses	−0.0663	−2.32**	−0.0237	−3.25**	−0.0038	−3.69**
Depreciation	−0.0600	−1.15	−0.1678	−9.35***	−0.0485	−5.11***
Productivity	1.7527	2.23**	0.7212	2.09**	0.0456	0.24
HumanCapitalEd	1.5789	1.37	6.8049	3.49**	0.0022	0.05
Fixed effects						
Firm	*		***		**	
Year	*		*		NS	

Note: Farm Size 1 corresponds to limited resource, retirement, and residential farms. Farm Size 2 corresponds to farm/lower sales and farm/higher sales. Farm Size 3 are large family farms and very large farms.
*, **, and *** denote statistical significance at the 0.10, 0.05, and 0.01 confidence levels. NS denotes "not significant."

As shown in table 4, both farm and nonfarm capital were significant in all regions, but had differential impacts on wealth. For example, a $1,000 change in *farm capital* in the Lake States would raise wealth by $453, compared to $103 in the Corn Belt and $278 in the Southeast. Also, a $1,000 change in *nonfarm capital* would raise wealth by $632 in the Lake States, by $1,378 in the Corn Belt, and by $2,218 in the Southeast. The different impacts across regions may be partly due to differences in the opportunities and multiplier effects available

Table 4. Regression Results for Change in Wealth and Profits Equations by Region: Lake States, Corn Belt, and Southeast (1996–2002)

	Lake States		Corn Belt		Southeast	
Variable	Estimate	*t*-Value	Estimate	*t*-Value	Estimate	*t*-Value
Change in wealth equation						
FarmInc	0.4028	2.48**	0.3323	1.41	−0.9596	−2.26**
NonFarmInc	1.5043	1.50	0.4800	0.81	−0.2574	−0.20
ChngFarmCap	0.4533	17.14***	0.1028	5.27***	0.2776	23.32***
ChngNFarmCap	0.6321	3.85**	1.3783	7.25***	2.2177	9.27***
Consumption	−2.5824	−1.25	0.9489	0.88	0.1850	0.07
Fixed effects						
Year	NS		*		*	
Profits equation						
CashFlow	0.0177	4.67***	0.0232	7.27***	0.0070	1.77*
TotalExpenses	−0.0031	−0.66	−0.0161	−5.30***	−0.0044	−0.96
Depreciation	−0.0566	−3.00**	−0.0910	−3.50**	−0.0789	−4.97***
Productivity	5.1918	3.43**	−1.5778	−2.86**	−0.1505	−0.63
HumanCapitalEd	−16.1208	−5.26***	−3.9766	−1.32	2.0530	2.43*
Fixed Effects						
Firm	**		***		***	
Year	NS		**		NS	

*, **, and *** denote statistical significance at the 0.10, 0.05, and 0.01 confidence levels. NS denotes "not significant."

off-farm in the regional economies. In all regions, the higher regression coefficients for "changes in nonfarm capital" imply that there are economic incentives for shifting resources out of agriculture and into nonagricultural uses.

"Nonfarm income" was significant for mid-sized farms when farms from all three regions were combined (table 3). This may be because off-farm income is more stable over time than is farm income for small-sized firms, and off-farm income may be a small part of large farms' total wealth, thus the lack of statistical significance in explaining changes in wealth (Mishra et al.).

Farm profits (equation (6)). There were diverse results across regions for the profits equation (table 4) reflecting different commodity specializations across regions. "CashFlow" (gross sales) and "Depreciation" were significant in all three regions. "HumanCapitalEd," which represents the productivity and investment components of human capital was significant in the Lake States and Southeast (table 4), and for mid-sized farms (table 3). The productivity variable was significant in the Lake States and Corn Belt. Combining the state-level total factor productivity variable with the farm-level variable (i.e., gross value of production divided by total cash expenses) gives a significant relationship between profits and productivity for small and mid-sized farms (table 3). The coefficient for productivity decreases as farm size increases.

Implications of the Results

These results generally agree with other studies of convergence of time-series returns on farm investments, and with other studies that have used farm-level data to empirically assess wealth and income patterns across states, farm types, and commodity specializations. We suggest three implications of these results.

First, although U.S. farm sector returns are converging over the 1960–2002 period and across regions, farm profits still vary widely by farm type, farm size, location, and by other factors. Constructing a pseudo panel using pooled farm-level data and estimating the system of equations linking wealth, income, profits, and productivity helps explain the linkages between the various components. For example, the finding that both the changes in farm and nonfarm capital are significant in all three regions suggests that nonfarm capital is a substitute for farm capital. This indicates that farm households have diversified their portfolios.

Second, changes in farm and nonfarm capital have differential impacts on farm wealth by farm location and by farm size. In general, the fact that changes in nonfarm capital have larger impacts than do changes in farm capital across all regions implies that there are economic incentives to shift resources out of agriculture. However, this may not happen because there appears to be incentives for small-scale farms to increase their capital levels.

Third, we found evidence that farm size affects both farm wealth and profits, and that the relative impacts of the "farm size" variable vary across these three regions, indicating differences in profitability across the different commodities produced in each region. We also found evidence that a firm's cumulative investment in human capital and productive resources is important in the Lake States and the Southeast, but is not statistically significant in the Corn Belt. This implies productivity differences exist across the commodities that dominate production in each region. This is important because productivity growth is expected to be a key to future profitability for each region's agricultural sector.

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